Growth and yield parameters using gamma rays in bhendi (Abelmoschus esculentus (L.) Moench) var. arka anamika

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Abstract
The effect of gamma rays on morphological characters and yield parameters in bhendi was studied by treating the seeds with different doses of gamma rays (10, 20, 30, 40, 50 and 60 KR). The germination percentage, days of first flower, root length, shoot length, seedling survival, number of fruits per plant, fruit length, seed yield per plant, fresh weight per plant, dry weight per plant, 100 seed weight, decreased with increasing level of gamma rays treatment.

Key words: Gamma rays, Krad (KR), Mutation, Bhendi.

Introduction
The use of gamma radiation to induce mutation is a method that has been applied in plant breeding to increase genetic variations (Brunner, 1995). In ornamental horticulture, radiation has been used to alter the color and form of flower type of inflorescence, fertility or leaf color variegation depending on the objectives of the breeder. Many instances have been reported on the use radiation-induced mutation to produce novel flower colors, such as the use of ion beams to change the color, form and number of petals in Chrysanthemums (Matsumura et al., 2010). X-rays were used to create Begonias to different flower colors and forms as well as variegated leaves (Roest et al., 1981). Gamma radiation can be useful for the alteration of physiological characters (Kiong et al., 2008). The biological effect of gamma-rays is based on the interaction with atoms or molecules in the cell. These radicals can damage or modify the important components of plant cells and have been reported to affect differentially the morphology, anatomy, biochemistry and physiology of plants depending on the radiation dose (Ashraf et al., 2003). The irradiation of seeds with high doses of gamma rays disturbs the synthesis of protein, hormone balance, leaf gas exchange, water exchange and enzyme activity (Toker et al., 2005).

Mutation breeding has been widely used for the improvement of plant characters in various crops. It is a powerful and effective tool in the hands of plant breeders especially for autogamous crops having narrow genetic base (Mickey, 1988).

In any mutation breeding programme, selection of an effective and efficient mutagen is very essential to produce high frequency of desirable mutation. Many chemical mutagens have been employed for obtaining useful mutants in various crop species (Singh and Singh, 2001). The role of mutation breeding increases the genetic variability for the desired traits in various crop plants and have been proved beyond doubt by a number of scientists (Tah, 2006; Adamu and Aliyu, 2007; Khan and Goyal, 2009; Kozgar et al., 2011; Mostafa, 2011). Several factors such as properties of mutagens, duration of treatment, Ph, pre and post treatment, temperature and oxygen concentration etc. influence the effect of mutagens. Bhendi (Abelmoschus esculentus (L.) Moench) is widely a grown vegetable. The immature fruit is eaten green either fresh or prepared, by boiling or frying and used in soups and stews (Bleasdale, 1984). Its nutritional value lies in its high amount of calcium and phosphorus. It also contains protein, carbohydrate and fat and some amount of vitamins (Tindall, 1983). Because of the nutritional and economic importance of okra, it is imperative that adequate attention be given to ways of producing the seed in such a way that high quality is ensured.

The major aim of a gene bank curator is to conserve seeds in a way that would ensure high quality for a long time. Even if storage condition is ideal, seed longevity is still known to be affected by the crop production procedures which are adopted by the farmer. The physiological state at which a seed is harvested and the position of fruit on the mother plant are two of such pre-storage factors. Even though bhendi is cultivated to a larger extent throughout the year, the productivity is very low. There is not much variability in bhendi in the Indian subcontinent and most of the available varieties give poor yield and are highly susceptible to the yellow vein mosaic virus. Variability is a pre-requisite for any breeding programme to
evolve high yielding varieties with other desirable attributes. In such a situation, induced mutations can be used to generate useful variation in quantitatively inherited characters. Among the various mutagen, gamma rays is the potential mutagenic agent for the induction of mutations. In the aid of the above facts the present study was undertaken to study the effect of gamma-rays on germination and seedling vigour in bhendi.

**Materials and Methods**

Dry seeds of bhendi variety Arka Anamika were collected from Tamil Nadu Agriculture University (TNAU), Coimbatore, Tamil Nadu. The gamma ray was subjected with 10, 20, 30, 40, 50, 60 KR of CO\(^{60}\) at the centre for genetics and plant breeding at Indian Council Agricultural Research (ICAR), Coimbatore and untreated dry seeds served as control. The experiment was conducted at Department of Botany, Annamalai University during the year 2011. The experiment was set up in a completely randomized design with eleven treatment in three replications, observations regarding germination percentage and seedling vigour index (SVI) were recorded on 10\(^{th}\) day after sowing and the results were analysed statistically (Panse and Sukhatme, 1985). These treated seeds were sown on 50 seeds with spacing of 30 × 20 cm in plots.

**Results and Discussion**

In respect of gamma ray treatment, there was a proportionate reduction in germination of bhendi with decreased dosage of gamma rays and similar results were reported in blackgram (Ramaswamy, 1973), soybean (Balakrishnan, 1991) and rice (Ramesh, 2010). Soybean (Pavadaid et al., 2010) and Cowpea (Gnanamurthy et al., 2012).

The seedling survival reduced with increase in dose of gamma rays. Similar results have been obtained in soybean (Yamashita and Kawai, 1987; Balakrishnan, 1991). Packiaraj (1988) studied by the effect of gamma rays on cowpea varieties and hybrid was reported progressive decrease in germination, survival seed yield per plant, number of fruit per plant, fruit length per plant with increasing dosage of gamma rays.

In the present experiment, per cent of germination, number of fruits per plant, fruit length per plant, seed yield per plant and fresh weight per plant, dry weight per plant, 100 seeds showed a decreasing trend when compared to the control (Table-1) and days to first flower increased with increase in dose of gamma rays (Table-1).

**Table-I: Effect of gamma rays on growth and yield parameters in bhendi (Abelmoschus esculentus (L.) Moench) in M\(_1\) generation**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Growth Parameters</th>
<th>Yield Parameters</th>
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<tbody>
<tr>
<td></td>
<td>Germination (%)</td>
<td>Seedling survival (%)</td>
</tr>
<tr>
<td>Control</td>
<td>94.66</td>
<td>90.00</td>
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<tr>
<td>Gamma rays</td>
<td>10 KR</td>
<td>90.66</td>
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<tr>
<td></td>
<td>20 KR</td>
<td>84.00</td>
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<td></td>
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<td></td>
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References


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